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New Concept Design for Mikma Coffee Grinder to Increase User Base

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Moscow IQP Project A-Term

Abstract

Our project focused on helping Mikromashina, a Soviet-era company with an aging product line, to improve its brand image and consumer base. Our main objective was to produce a new design for one of Mikromashina's flagship products - the coffee grinder, whose sales have slowed in recent years. The proposed design, a manual burr grinder that incorporated features unique for this class of product, is detailed from concept to manufacturing stage in this report. It is informed by extensive market research, interviews with experts, and focus groups with consumers. The combined American-Russian team delivered a CAD model of the final design, ready for prototyping, and an economic analysis of the relevant production costs and profit margins.

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Chapter One: Introduction

In Russia, there are many products on the market that are effective in carrying out the task they were designed for, but do not meet the specific wants and needs of the consumer. While often designed with a high degree of engineering expertise, these products suffer in areas including aesthetics, pricing, and offering the secondary benefits desired by the market. When looking at products that serviced a minority market, such as coffee related appliances sold in a country that favors tea, it was easy to see how the use of consumer research in the design process could be neglected until now. This was the situation that Mikromashina had found itself it with its line of coffee grinders. While very functional, they were not selling as well as they could. Similar to most national brands, Mikma's coffee grinders neither served the luxury market captured by European manufacturers, nor could not compete with the prices set by Chinese and other East Asian producers. The goal of our project was to provide Mikromashina with a design for a coffee grinder, based on real market research, that would service the Russian consumer in such a way that it would sell regardless of the challenges the company currently faced.

During the times of the Soviet Union, Mikma was the sole manufacturer of small appliances in the Moscow area. Facing no competition, it did very well and maintained an adept engineering team producing lines of simple and durable functioning products. With the collapse of the Communism though, it faced the crisis of all state companies, confronted with a huge influx of foreign entities with more advanced marketing and design programs than itself. With this growing trend of younger Russian consumer towards imported goods, to remain competitive, domestic manufacturers needed to offer advanced features to survive in the market place. Outside companies such as Mr. Coffee had already started marketing coffee making products towards this emerging consumer group. Most Russian designs, while rugged and effective, lacked the aesthetic appeal and advanced features of foreign competitor's products. Combined with a lack of brand awareness among younger consumers, this caused Mikma's sales to fall drastically over the past five years. Seeing the market shift away from itself provided the impetus for Mikromashina to ask for help to re-capture the attention of these consumer groups, and led to the creation of our IQP.

In order to better help Mikromashina adapt its products to these developing markets, an entirely new strategy was needed. This plan would be focused on the Russian consumer in a way that shaped the design of the new product based on market feedback, and resulted in something more appealing to consumers. To establish the design and performance goals for the new coffee grinder, we conducted background and consumer market research, while factoring in Mikma's production capabilities. We collected market and consumer data and incorporated it into the engineering and design process, which defined the coffee grinder's functions, and design. To fulfill the overall goal of our project, this design was then illustrated in a 3D CAD modeling package, and presented to Mikromashina. Our Russian partners from the Financial University also performed a financial analysis of our final grinder design, further increasing the product's market viability. To ensure the quality of our recommendations, the 3D model was given to focus groups to obtain feedback, resulting in a final improved iteration of the grinder.

To gather the required data to conceptualize this new product, a combination of focus groups, and thorough market research were used. Our Russian partners were integral here, both in their own knowledge of the market, and in their help to set up the focus groups. Additionally, we conducted a comparative analysis of Russian-US market trends, hoping to gain insight into what features would work best in the Russian market. We concluded that, due to cultural differences, a popular product in one country will not necessarily succeed in the other. Thus, we could not look at successful products from the US and draw direct conclusions on what should be included in our design for Mikromashina. This ultimately led to more market research within Russia, but led to a market driven design. Additional focus groups were held approximately four weeks into the project, reinforcing our previous findings on coffee grinder consumers and confirming decisions made during the design process.

Chapter Two: Background

2. Introduction

The background of this project consisted of both preliminary research, and that done while working on the design of our coffee grinder during the stay in Russia. As such, we were able to begin our project with a very broad focus, and narrow it as the design's initial stages progressed. This allowed for us to keep the state of the market as a whole in mind, while simultaneously having details relevant to specific mechanical aspects of our project. In the research for this project we considered many different areas: the coffee markets, the small appliance markets, companies identified as Mikromashina's competitors, coffee grinders similar to those Mikma produced, and various parts that make up coffee grinders. The information we obtained at this stage proved useful further along in our project.

2.1. Research of world markets for small appliances

2.1.1. Overall Market Size and Growth Trends

Small appliances like coffee grinders represent a significant segment of the household cooking and appliance manufacturing industry, holding approximately 19% of the market share. The household appliance industry represents approximately $213 billion in annual revenue globally. While this revenue has been steadily decreasing in recent years due to the global economic slowdown, it is predicted to increase to almost $260 billion by the year 2017 aided by greater efficiency within the industry. This efficiency would be achieved due to a greater focus on R&D, sales, and marketing by brand owners, funded by money saved as a result of increased outsourcing of manufacturing operations ("IBISWorld Global Industry: Company and Business Research Reports and Information," 2013). Since 2005, relocation of production facilities to Asia has been the trend in appliance manufacturing, resulting in significant savings stemming from much cheaper labor. Despite the general decrease in the size of the appliance market over the past several years, the small appliance manufacturing sector increased as a percentage of total

revenue, almost offsetting the effects of the recession. At present, the short-term industry outlook is positive, with an expected growth of 4% in the year 2013 alone, as the below chart indicates. The long-term outlook, however, is uncertain as steel prices are expected to increase over the next five years, and to begin to significantly affect production costs. Despite this, the appliance manufacturing market is mature, and can expect slow to moderate growth for the foreseeable future after the recovery from the current economic slowdown ("IBISWorld Global Industry: Company and Business Research Reports and Information," 2013).

IBISWorld
WHERE KNOWLEDGE IS POWER

C2521-GL Global Household Cooking & Appliance Manufacturing

Key Statistics

	Revenue (%)	IVA (%)	Establishments (%)	Enterprises (%)	Employment (%)	Exports (%)	Imports (%)	Wages (%)	Domestic Demand (%)	World price of steel (%)
2003	10	8.9	0.7	0.6	-2.6	N/C	N/C	7.1	N/C	4.5
2004	7.9	5.5	4.1	4.1	-0.1	N/C	N/C	6.2	N/C	34.4
2005	1.3	1	9.8	9.8	0.5	N/C	N/C	-3.6	N/C	8.5
2006	3	1.2	0.1	0.2	5.8	N/C	N/C	-0.7	N/C	9.1
2007	6.7	3.5	-0.4	-0.4	1.8	N/C	N/C	3.6	N/C	5
2008	0.7	-1.7	0.6	0.6	1.8	N/C	N/C	1.1	N/C	20.6
2009	-7.7	-6.6	-1.3	-1.3	4.3	N/C	N/C	-9	N/C	-25.1
2010	1.5	0.6	-1.2	-1.2	4	N/C	N/C	0.7	N/C	16
2011	1.9	0.9	0.3	0.3	3.9	N/C	N/C	1.5	N/C	12.8
2012	0.7	0.1	0.2	0.2	4.5	N/C	N/C	0.2	N/C	-2.9
2013	4	3.4	0.9	0.8	4.7	N/C	N/C	3.4	N/C	3.1
2014	4.1	3.4	0.9	0.9	4.9	N/C	N/C	3.5	N/C	3.8
2015	3.9	3.3	1	1	5.1	N/C	N/C	3.4	N/C	2.6
2016	4	3.3	1	1	5.3	N/C	N/C	3.5	N/C	1
2017	4.2	3.5	1.2	1.2	5.5	N/C	N/C	3.6	N/C	2.5

Figure 1: IBISWorld Global Household Cooking Revenue ("IBISWorld Global Industry: Company and Business Research Reports and Information," 2013)

2.2. **Research within Russia**

2.2.1. **User demographic**

Despite having recently emerged from a slowdown, the Russian small appliance market has experienced steady growth since 2009. Between 2007 and 2011 there was a 14.1% compound annual growth rate and the food grinder segment of the market did even better than that. These trends, and the effect of the recession, are visible in the graph below. Ignoring this strong growth, the gross revenue was still comparatively small, with the household appliance industry earning just over $10

billion annually, of which the food processor segment made up approximately $375 million. When examined in combination with the fact that the average Russian consumes only 0.7 kg of coffee annually, compared with the 4-6 kg of most western nations, it was apparent that the Russian consumer base for coffee grinders was relatively small (Bojor, 2010).

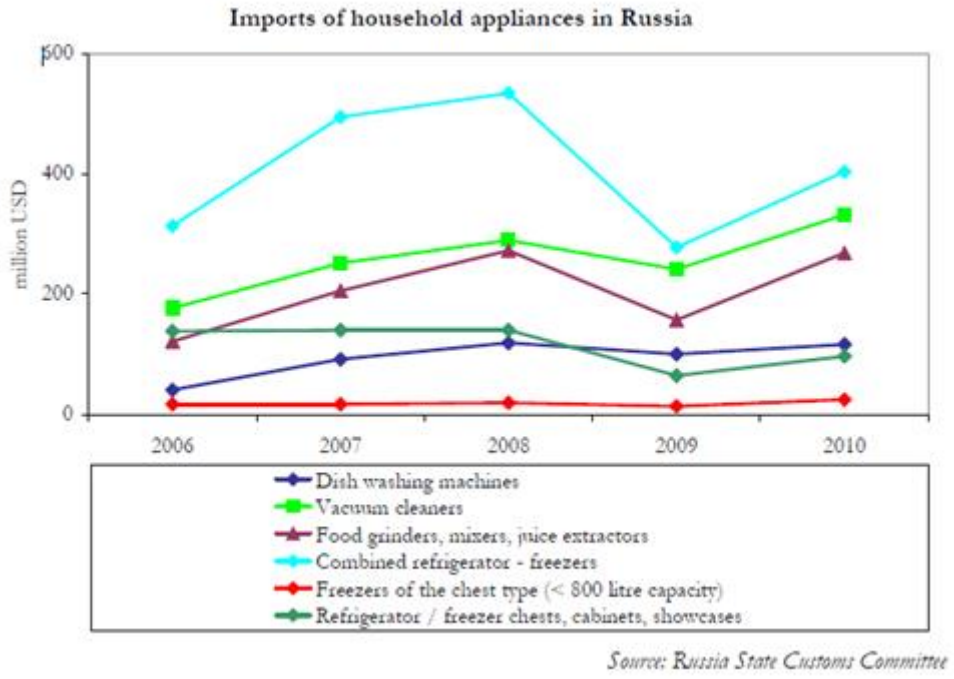

Figure 2: Imports of household appliance in Russia (Bojor, 2010)

2.3. **Small Appliance Market Research within US**

2.3.1. **Food Processor market Trends**

Within the United States, the food processor industry, which includes coffee grinders, was hit hard by the recession, and had negative growth of 3.6% for the past several years, with a gloomy outlook for the present through 2018. This data can be seen presented on the table below, which also shows the maturity of the market, based on the number of companies involved and relatively stable growth. It is worth noting that food processors have fared better than the appliance industry as a whole

though, which had a 6.3% reduction in revenue over the past five years, and has an even grimmer outlook going forward ("IBISWorld US Industry: Company and Business Research Reports and Information," 2013). After the recession, revenues in the food processor market were reduced due to American companies having to lower markups in order to compete with cheaper brands manufactured abroad. Introducing goods into the market as the economy recovers and average disposable income is on the rise could present a lucrative opportunity for non-US appliance manufacturer focused in food processors. This would mean taking advantage of the upturn, while having avoided the worst of the recession.

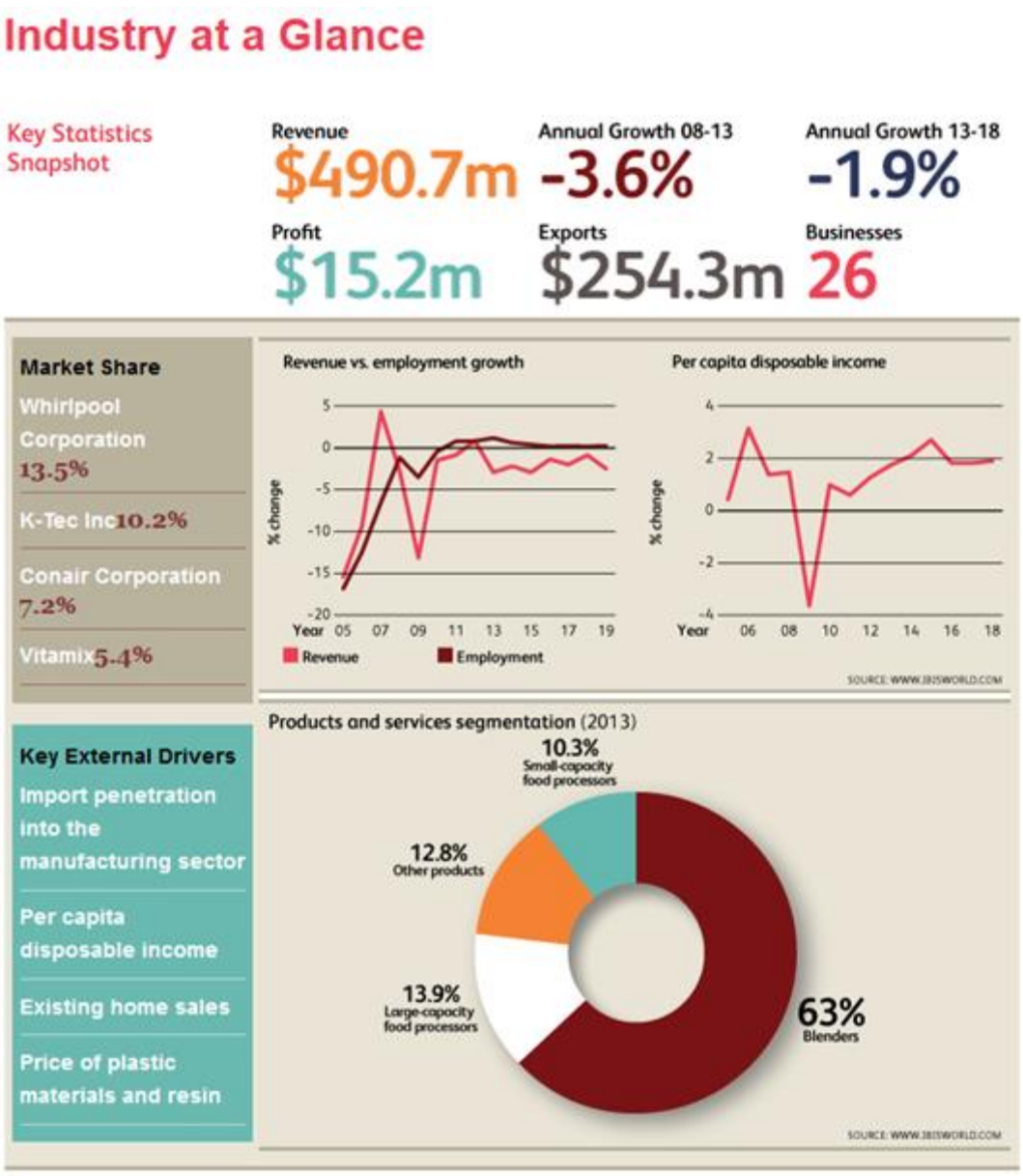

Figure 3: Industry at a Glance ("IBISWorld US Industry: Company and Business Research Reports and Information," 2013)

2.4. **Coffee Consumer Research**

2.4.1. **Differences between Russian and American consumers**

In terms of the appliance market as a whole, both Russian and American consumers were recovering from economic slowdowns. Recently, a majority of consumers have been hesitant to spend money on new household appliances. The major

differences as they relate to the sales of coffee grinders were in the consumer's rate of coffee consumption, rather than in their tendency to buy small kitchen appliances. Americans consume on average more than four times the amount of coffee than Russians ("WRI Coffee Consumption Map," 2009). While this does not directly translate into the number of people using coffee grinders versus people buying pre-ground coffee, with a discrepancy this large, the United States still represents a much larger market for coffee grinder sales, especially when the differences in the country's populations are considered. The vast differences in these markets mean that we cannot draw conclusions directly from successful American products; what was successful in the US may not also be successful in Russia. While this does not directly reveal what we need to do, it cautions against what we should avoid, and emphasizes the need for targeted market research. This was extremely difficult during the preliminary stages of the project, but became possible once we were joined by our Russian partners who had the knowledge of where to look for this information, and the ability to read it.

2.4.2. **Coffee Consumers in Russia**

To understand the Russian coffee consumer a better knowledge about how much coffee the typical Russian drinks was needed. Compared with most other coffee consuming countries, Russians tend to drink significantly less. According to ("Russian Coffee Market Trends," 2013), less than half of the total population drinks coffee. This was partly due to the popularity of tea, with over 82% of the total population drinking it on a daily basis; because of this, businesses found it difficult to convert tea consumers to coffee (Martinchik, Baturin, Martinchik, & Tutel'ian, 2005). However, with the westernization of Russia over the past several decades, the coffee gained a foothold in the population. During this time, the average per capita coffee consumption and market share of the product both increased significantly ("The 2005-2014 Outlook for the Coffee Market in Russia," 2010). It is worth noting that with this growth and increased demand, the price of coffee nearly doubled. This was compounded by the fact that over 90% of coffee sold in Russia is imported ("Russian Coffee Market Trends," 2013). Larger numbers

of Russian consumers may have wanted to drink coffee, but the prices remained too high to challenge tea. The overall conclusion we drew from this was that coffee remains a luxury product in Russia. Additionally, the availability of pre-ground coffee meant that a significant portion of those who did consume coffee would not buy a grinder. Therefore, a consumer who was going to buy a coffee grinder would do so because they were heavily involved in the process of making their coffee, and may even treat it as artisanal. This meant any coffee grinder we designed needed to reflect the "special occasion" of the beverage they are about to make. Regardless of the technological complication of the product, the little things such as finishes and build quality would be deciding factors in a customer's purchasing decision.

2.4.3. **Small appliance sales in Russia**

Russia has steadily increased production and import of appliances since the fall of communism and the final dissolution of the USSR in 1991. Having a population of over 145 million, the demand for appliances was strong. With only $28.8 million in small appliances sales in 2006 the market was still maturing, and there was ample room for growth ("Market Research Report August 2011," August 2011). Most appliances were imported into Russia, but the national appliance industry was still growing rapidly. With stronger market growth, products produced within Russia were gaining a bigger proportion of sales. With 8% growth in appliance sales in 2011 as compared to 5% in Western Europe, Russia needed more appliances to keep up with demand ("Russia leads Europe's small appliance growth," September 2011). In particular, coffee makers achieved an almost 18% growth in European countries including Russia (Eisenblätter, August 2012). Such companies as Медиа-Маркт, Indesit Co, and M.VIDEO have been leading the way in small appliance sales and electronics in Russia with over 8.8% growth in some cases (Eisenblätter, August 2012). The implication here was that both the coffee and small appliance markets had been experiencing growth. This meant that while producing a coffee grinder, we could be confident that while once on the market it would sell. It also gave additional companies whose products we could look at, in order to see which features were most popular on the Russian market.

2.5. **Research of competition**

In order to produce a successful coffee grinder design, it was important to understand the competition. We found that the market tended to break down into luxury coffee grinders, produced in Europe and America, and simpler but cheaper items produced primarily in China. Of these, the cheaper but functional Chinese products were more similar to those produced by Mikromashina, and therefore, represented their direct competitors. It was apparent that one of the reasons that Mikma's coffee grinder sales were suffering was an inability to compete with the prices of the Chinese imports; thus, we would need to approach the design from a new angle. The higher grade coffee market was similarly saturated, and would be almost impossible to breach, considering the difficulty in producing coffee grinders with such a high number of features, built to a quality standard. The most open part of the coffee grinder market seemed to be manual coffee grinders; very simple, but with a high build quality and finish. While multiple companies producing these products existed, there were fewer of them than in other sectors, and there was more room for improvement in the products.

2.5.1. **Differences in Coffee Grinders**

It was clear from these examples (see Appendix A) that coffee grinders were set apart based on a few key differences. The simplest class of grinders was made of small, hand-powered devices that are limited in their customizability. Next were small, motorized blade grinders. These products had a wider variety of uses, but were not be as effective at grinding coffee as other products. The continuing levels of grinders were all based on a burr grinding mechanism. These products were differentiated based on volume, build quality, and the class of the grinding mechanism.

There were a certain set of features that all successful products appeared to have: safety measures, variable capacity, variable grind settings, and extra space for coffee beans. In short, all effective designs offered some amount of control to the user. It was therefore important try to incorporate such features into our coffee grinder

design. Additionally, the majority of products on the market existed within a fairly small price range, generally between twenty and seventy dollars. In order to create a truly successful design in this area, it was necessary to balance a wide array of features with a reasonably low cost.

2.6. **Current Mikma Products**

Figure 4: Mikma IP30 ("Mikromashina resources," 2013)

2.6.1. **IP 30 Grinder**

The Mikma IP 30 grinder was a very simple product. It had a blade grinder with no hopper. The only element of control the users have over the grind is the length of time they press the button. This grinder was not known for its reliability, or its consistency. The mechanical parts were imported from Chinese wholesalers and had a tendency to burn out with too much use ("Mikma IP-30 product reviews," 2013).

Figure 5: Mikma IP32 ("Mikromashina resources," 2013)

2.6.2. **IP 32 Grinder**

This grinder was described as a redesign of the previous model. However, it was based on the same blade grinder design, and suffered from the same hardware faults as the previous model. A new Mikromashina coffee grinder would need to improve on many of these features in order to be successful in the market.

2.7. **Coffee Grinder Design Aspects**

2.7.1. **Grinder Designs**

To make coffee, the whole bean must be crushed in order to facilitate the brewing process. Beyond just grinding the bean, the overall fineness (size of coffee ground) of the final ground greatly affects the final taste of the coffee. The quality of the grind also affects the taste as a more uniform ground brews better ("Grinders 101 - A Beginners Guide," 2013). Since the grind was so important to the taste, the method used to achieve the final ground was very important. There are several types of grinding methods that can be used, but the most popular methods are burr grinders and blade grinders.

2.7.1.1. **Blade grinder**

A blade grinder uses a high speed rotating blade powered by an electric motor that chops material in order to produce grounds. Blade grinders are used in a wide variety of food preparation devices including blenders and food processors. The shape of the rotating blade greatly affects the type of ground produced. For example a sharp edged rotating blade will slice material, while a blunt edged blade will shred or crush material. For the preparation of coffee, a blunt edged blade is always used. This allows for the beans to be aggregated into smaller pieces until reduced into a grind size ("Grinders 101 - A Beginners Guide," 2013). Typically the blades in coffee grinders rotate at very high speeds, which can reach between 20,000-30,000 rpm in some cases. Due to the simple design of the blade grinder they tend to be very inexpensive when compared to other grinding methods. Additionally, since there is only one moving part in this type of grinder they are very reliable and tend to be more compact in size. These advantages are offset by several disadvantages, however. Blade grinders do not produce consistently sized grounds, which negatively impacted the quality of coffee made with them. This type of grinder is also incapable of producing coffee grounds fine enough to prepare certain coffees such as Turkish, espresso, or cappuccino. Another serious disadvantage of blade grinders is the possibility to burn coffee grounds, which ruins any coffee made with them. The high speed of the blade can generate enormous friction, creating enough heat to burn the resulting coffee grounds, ruining any beverage made using them. This typically occurs when blade grinders, without an automatic cutoff, are used without stopping for especially long periods of time. Finally, since the blades spin at a high rate of speed, the noise produced by this type of grinder can be quite loud ("Burr Grinder vs Blade Grinder – Which One Is The Best?," 2013).

Figure 6: Blade Grinder ("Burr Grinder vs Blade Grinder – Which One Is The Best?," 2013)

2.7.1.2. **Burr grinder**

One of the most popular methods of grinding coffee is the burr grinder (also called a burr mill). This type of grinder is typically used to grind hard and small food products such as salt, spices, poppy seeds, and coffee. The material to be ground is placed between two rotating abrasive surfaces at a set distance away from each other. As the material is forced between the rotating surfaces, it is crushed into a consistently sized powder. The fineness of the ground can be controlled by adjusting the distance between the burrs. The larger the distance the coarser the ground will be and the closer the distance the finer the ground will be. This type of grinder may be powered either electrically or by hand. Due to the nature of the grinding element, burr grinders rotate at a slower speed than blades; as such they do not produce as much heat due to friction. For the same reason, burr grinders also produce less noise than blade grinders. The major disadvantage of burr grinders is a higher production cost, compared to blade types ("Burr Grinder vs Blade Grinder – Which One Is The Best?," 2013). They also take up more room since the mechanism is more complex. Lastly, the complex construction of the burr makes them difficult to

clean without disassembling. Burrs fit into two categories; flat and conical.

2.7.1.3. **Flat Burr**

This type of grinding element uses two shallowly angled burrs, with the grinding surfaces facing one another. The disks are mounted on top of each other so the tapered edges of both discs meet. The burrs rotate at a high speed, and as the coffee beans are forced between the two discs they are crushed into smaller and smaller particles ("Grinder burr types explained (flat, conical, DRM)," 2006). Typically, a flat burr rotates at around 1000 rpm. By changing the distance between the burrs the fineness of the ground can be controlled to a significant extent. This method works well with most coffee types, but cannot usually achieve the fineness necessary for the Turkish variant ("Grinders 101 - A Beginners Guide," 2013).

Figure 7: Flat Burr Grinder (Frew, 2007)

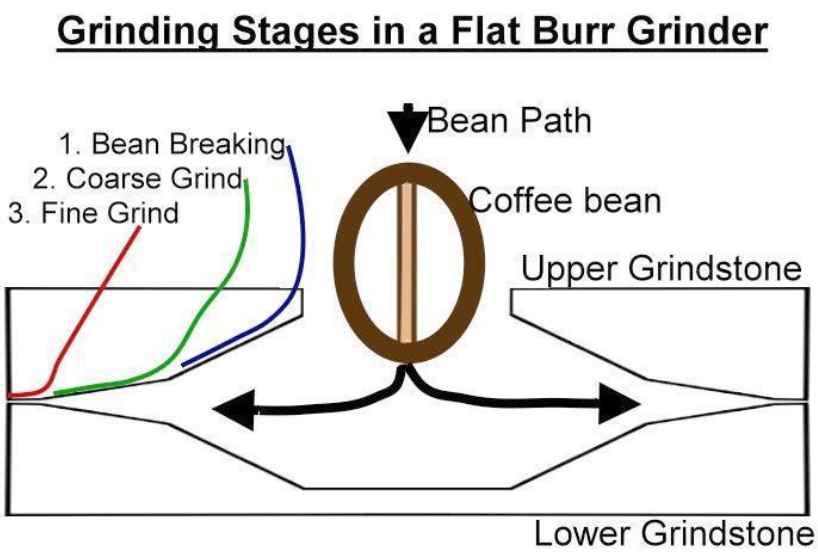

Figure 8: Flat Burr Grinder Diagram ("Grinder burr types explained (flat, conical, DRM)," 2006)

2.7.1.4. **Conical Burr**

This type of grinder uses a steeper angled burr, which tapers outwards, and a solid inner burr mounted inside. This creates a gap between the two burrs that decreases in size towards the bottom. The inner burr, the conical piece which can be seen in the picture below, rotates rapidly. It catches the substance being ground in its ridges, and breaks them against those of the outer burr. When the substance (in this instance is a coffee bean) reaches the desired size and, can fit through the gap between the two burrs, the grinding process is done. This produces an extremely consistently sized ground. Typically a conical burr rotates at around 500 rpm. By moving the outer burr vertically the size of the gap can be adjusted giving a user almost absolute control over the ground fineness ("Communicating Grind Size," May 2010). This method produces the best coffee ground and makes less noise and heat than other methods ("Grinders 101 - A Beginners Guide," 2013).

Figure 9: Burr Grinder ("Burr Grinder vs Blade Grinder – Which One Is The Best?," 2013)

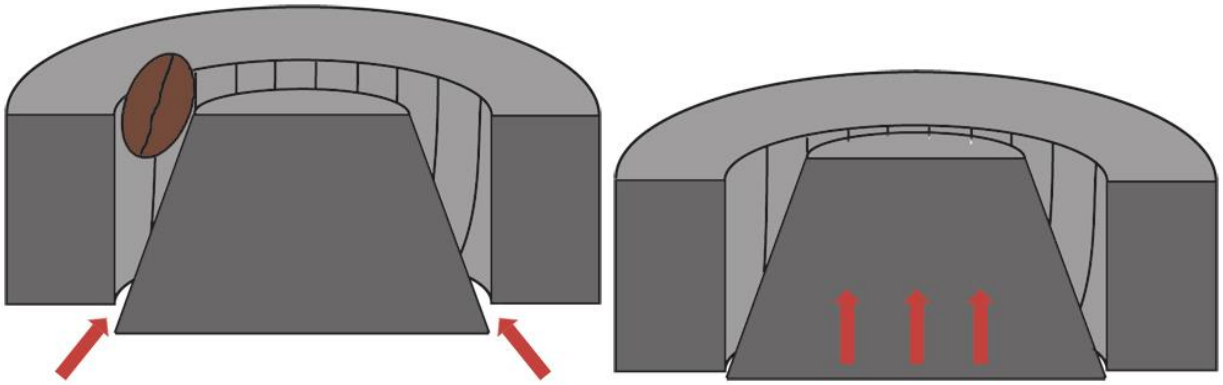

Figure 10: Burr Grinder Spacing ("Communicating Grind Size," May 2010)

2.7.2. **Hopper and bin designs**

The hopper and bin play a key part in the utility of a coffee grinder. The hopper is the container in which beans are stored before they are ground, usually located directly above the grinder. Some grinders, most commonly manual burr, in which the beans are fed directly into the grinding element by hand, do not have hoppers. Once the grinding process is complete, the grounds are gathered in the bin. Bin and hopper designs are largely dependent on which type of coffee grinder they are used in. For example, most blade grinders do not use a separate bin and hopper since the beans are held in a single chamber. Thus a single container acts as both the hopper and bin. Conversely, electric

burr grinder always use a separate bin and hopper since the beans need to be fed into the top of the burr and gathered once they are processed. Hoppers must hold the coffee beans in position and while forcing them into the grinding unit. They must be designed to not jam while feeding the grinding unit. Many hoppers also include graduated marks to measure out a set amount of grounds cups. The hopper may include a feed system, usually consisting of small rotating pushers, to force the beans into the grinder. The bin is simply a receptacle to hold the grounds as they fall out of the grinding unit. Most bins are removable for ease of use, and may feature graduated marks to measure the amount of coffee. Because it is desirable for the hopper and bin to be clear they are primarily made of plastic or glass. Plastic is generally inexpensive, and allows for a wide variety of shapes, but can attract static electricity which causes the coffee grounds to stick to the container. This makes cleaning the grinder difficult, and can hurt aesthetics. As it is nonconductive, glass does not have this issue, but there is obviously a trade off in price.

Figure 11: Hopper/Bin Design ("Mr. Coffee BVMC-BMH23," 2013)

Figure 12: Hopper Design ("Ascaso M-I Bean Hopper," 2013)

Chapter Three: Methodology

3. Introduction

In order to produce the highest quality coffee grinder possible our plan was to follow the official engineering process as closely as possible. This meant developing a thorough knowledge of our subject area, identifying Mikromashina's parameters and constraints, creating ideas, and using a quantitative decision making process to choose the best one. We went through as many iterations of this process as were necessary until the coffee grinder design was the best it could possibly be. This design process, which grew with the rest of our project, to include focus group feedback, and financial analysis by our Russian partners, took up the bulk of our project.

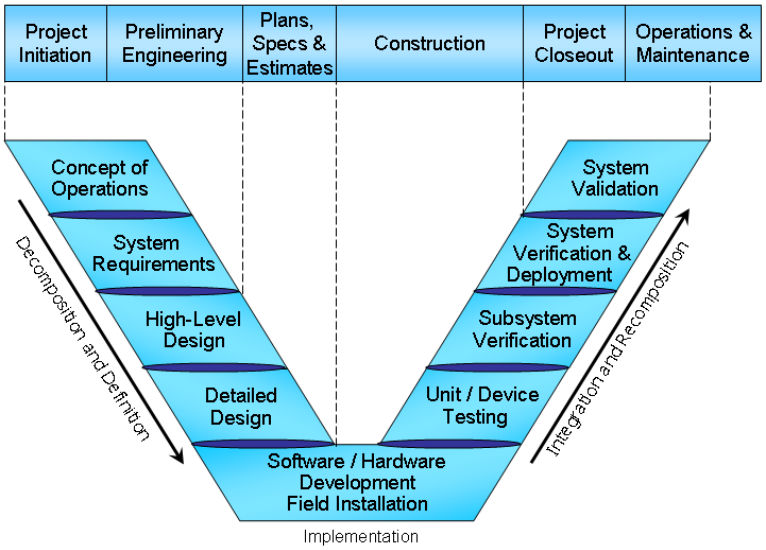

Figure 13: Engineering Process ("Engineering Design Process Chart," 2013)

3.1. Overall market research

Through the use of WPI's extensive collection of databases, we achieved a good background understanding of the coffee grinder market in Russia. This included both a general knowledge of small appliance sales in Russia, and more specific information, such as standard pricing for coffee grinders. Research was also conducted on the features and form factor of recently successful coffee grinders in Russia. The coffee grinder we

aimed to create would certainly be a unique device with tailored features, but currently successful models would help indicate which features were most popular. Having thorough background knowledge on all aspects of the coffee grinder market both in Russia and in the United States was a necessity during our mission to create an informed design.

3.2. **Refine project description**

Having started off with a broadly defined project it was important to determine and refine our sponsor's goals. In the case of this project, the design aspects came to the forefront, while the possibility of a physical prototype was removed almost immediately. This was achieved through email exchange and video calls Mikromashina, and further refined through an initial meeting with Mikma management personnel. Despite this, in part due to the language barrier, there was ongoing confusion in the early stages of the project over exactly what the deliverables would be. At one point the IQP's scope was even expanded to include a set of recommendations for new production equipment to be purchased and used in Mikma's factory. While this aspect was promptly removed, it reflects that the project's scope was extremely fluid during this time. In order to prevent further modifications, we laid out a plan with concrete phased timelines, and deliverables that would satisfy all core components of project. This plan was presented to personnel at Mikma, and met with approval. The overall deliverable for our IQP would be a final design, created based on market research and consumer feedback and modeled in 3D CAD, to be presented to Mikromashina. Additionally the final design was brought to focus groups and underwent an iterative process of refinement until it was judged to be ready for market. It should be noted though that this aspect of the project was a stretch goal, and that if it were not completed by the A'13 team, it was intended to be left for follow-up IQP groups.

3.3. **Budget enough time to produce CAD model**

Once the Project's objectives had been established, it was also be important to budget time for each step in the engineering process. Doing so would ensure that the project

remained on track, and help the group understand if it was falling behind schedule and either needed to attempt to speed up work, or adjust the project goals to be more feasible for achieving them in the given time. At this juncture, the overall goal of this IQP was to have a design ready for the sponsors by the end of the seven week period in Moscow, and if possible to organize focus groups to give us feedback on it. Initially, we set up deadlines for the first six steps of the engineering process, intending to conclude with a 3D model of our coffee grinder. As work progressed, it became clear that we needed a more formally structured schedule. We split our project deadlines into four phases that were more tailored to Mikromashina's specific needs. They were as follows:

Phase I: One to two weeks

Step 1- List all possible coffee grinder features (ex. blades, switches, timers)

Step 2- Separate all features into five categories, ranked from simplest to most complex

Step 3- Create 5 design concepts, based on complexity ratings

Phase II: Two weeks

Step 4- Present the concepts to Mikma management, and use feedback to decide which one to move forward with

Step 5- Refine the chosen concept using the engineering method, which includes sketching at least five possibilities and creating pro-con lists for each, and taking into account feedback from focus groups

Phase III: Up to two weeks

Step 6- Illustrate the final design in CAD

Phase IV: One week

Step 7- Go to Focus groups again for feedback on the final design, and if necessary further refine

3.4. **General, Dimensions, and Tolerances**

In terms of design criteria and parameters, external dimensions for the coffee grinder were influenced by a number of factors, primarily the production capabilities of Mikromashina's factory. We needed to set the minimum and maximum sizes and tolerances for various materials, based on the sponsor's manufacturing plants. Due to this urgency, the team attempted to gather the relevant information immediately when beginning work at Mikromashina, but encountered difficulties. Initially Mikma officials were hesitant to give any specific information on constraints out of a reluctance to interfere with the IQP's creative process. They wanted to give the design team as much freedom to include various features within the coffee grinder as possible, and felt that imposing limits would prevent this. From the perspective of the engineering process it was extremely difficult to progress without knowledge of what Mikma was actually capable of producing. As the issue was explored it became clear that Mikromashina's management did not have a clear idea of what type of product they expected. This was a major factor in the restructuring of the IQP. Preliminary design concepts were presented to Mikma's management. These changes proved to be very successful. After being shown five concepts, the Mikma engineering team quickly focused on the simplest. While this did not impose all constraints, such as size and tolerance production capabilities, it provided a good set of guidelines according to which the rest of the project could be conducted.

3.5. **Material requirements**

Material selection was based on Mikromashina's production capabilities. Due to the decision to design a manual burr grinder, the grinding elements had to be made of steel, unless Mikma outsourced manufacturing. In order to utilize Mikma's production strengths, all parts, with the exception of the handle and drive shaft, were designed to be made out of plastic. In the first round of focus groups, several people expressed the opinion that glass products were generally of higher quality than plastic ones. However, the stresses induced by grinding necessitated the choice of plastic over glass from the perspective of both durability and safety. As a compromise though, we recommended that the plastic components be made out of high grade copolyester, which shares the weight and feel of glass, but is significantly less brittle (Scheirs, 2003). It is important to

note that Mikma had not given any monetary constraints, so we were unable to make any hard decisions on specific material brands. The materials ultimately used would be based on Mikma's judgment of their utility versus cost. The Financial University students cooperating with the project developed models to measure the cost of production, which would prove useful during the manufacturing process.

3.6. **Additional research on coffee grinders**

In order to create a competitive product, it was important to have knowledge of other products on the market. This information was primarily gathered online, and from consumer databases, but supplemented by other customer experiences. It was necessary to become well-versed in the product's features, as well as their typical cost and customer satisfaction. The major theme of this research was the confirmation of the differences between the US and Russian coffee grinder markets. In Russia, coffee is still viewed as an exotic or luxury food item, and the people who prepare it themselves tend to think of the process as being artisanal. Coffee grinders are the realm of the true connoisseur; this meant that anything we produced would need a high quality finish, regardless of the overall complexity of the device.

3.7. **Create sorted list of features**

We next created a list of every feature that could be found in a coffee grinder. This was a freeform brainstorming activity, and all ideas were welcome. We supplemented this by looking through online stores and the US Patent Office's website, analyzing any coffee grinder we could find and identifying more features. The completed list was broken into fifteen categories, each representing a type of feature (e.g. aesthetic, grinding method), and further sorted into five grades of complexity. A total of 96 features were identified that could be incorporated into a coffee grinder design.

3.8. **Establish representative concepts**

Our next step was to establish five different coffee grinder concepts ranging from simplest to most complex. The sorted list of features led naturally into these concepts, as

the complexity rank we assigned each feature largely corresponded with the level of grinder it was used in. For clarity, we next matched each concept with similar products currently available on the market. The first, and simplest, grinder was manually operated, and used a conical burr. The second, analogous to Mikma's current product line, was an inexpensive blade grinder that tended to dominate the lower portion of the market. The third was an electric disk-burr grinder that produced a high quality coffee ground. The next concept was a higher end conical burr grinder that had a significant degree of adjustability, and was larger than the previous three. The last coffee grinder concept was mechanically similar to the fourth, but had additional ease of use features such as a screen, timer, and a larger bin and hopper. It was also the most expensive by far.

Figure 14: 5 Concept Designs from least to most complex

3.9. **Gather feedback from experts**

The next step in our project was to present our concepts to Mikromashina and move forward based on their reactions. We judged, for a variety of reasons, that the manual grinder concept was the best choice for Mikromashina to produce. First and foremost, it would appeal to the "coffee connoisseur" that our research had identified as being the primary consumers of grinders within the Russian market. Secondly, it could be built using components that Mikma could manufacture, which is not true of the other, more complex designs. Lastly, we found that manual grinders tended to have the greatest profit margin and represented the least saturated market segment. We presented the above to Mikma's management and their engineering team. While we received positive feedback on our work, we were not given a definitive answer on which concept we should proceed with at that time. Mikromashina wanted time to discuss internally which

concept they liked best. After several tense days of waiting we were happy to find that they agreed, and gave us the go-ahead to proceed with concept one.

3.10. Create sketches of each new designs

At this point it was necessary to sketch five design variants of a manual coffee grinder. Of all the steps in our design process, this one gave us the most creative and engineering freedom. As such, constructive debate began over everything including material selection, burr grinder type, and handle position. Ultimately though, we feel that this intense constructive criticism from each other lead to the best possible designs coming out of our creative process.

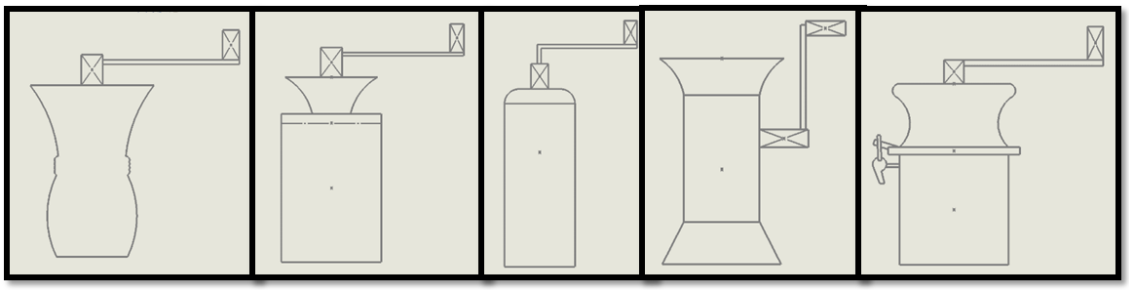

Figure 15: 5 Concept Sketches

Basic representations of the five designs we came up with are shown above. The first was effectively a baseline-standard for manual grinders, with a bulb shaped bin and open feed system for the burr grinder. The second had a cylindrical body, but would be made out of clear plastic to differentiate it in the market. The third was unique from the other four designs in that it had a lid that enclosed the grinding area, and a folding handle that made it very compact. The fourth would be similar in design to the second but had a side mounted handle. One of the major points of debate was whether this handle would improve ergonomics. We ultimately came to a consensus though, that while it may be easier to hold, moving it through the vertical plane would feel less natural than the horizontal. The last design was very similar to the first mechanically, but featured a sealable bin which could keep coffee grounds fresh for longer.

3.11. Conduct consumer research

It was important to gauge the feelings of potential customers in order to confidently proceed with our designs. This was determined primarily through the use of focus groups. These were organized through Financial University faculty, in collaboration with Mikma marketing, so we were not involved with the selection of participants. This gave us more time to focus on developing relevant questions and formulating discussion topics. We were not physically present at most focus groups to avoid any translation-caused disruptions and noise. Instead, we were given video recordings of the two focus groups conducted and reviewed them with a translator, Alevtina Yefimova. The opinions of the participants reinforced our analysis of the Russian coffee grinder market by generally considering the beverage a luxury item. The design team found this encouraging, showing us that we were on the right track trying to appeal to coffee aficionados, rather than reach the broadest possible market.

3.12. **Select an approach**

Our team wanted to select which design to proceed with in the most quantitative way possible. In accordance with the engineering design process, we composed a thorough list of pros and cons for each design. This helped to assess quantitatively where each was exceptional, and where each was lacking. Despite this decision making aid, there was significant debate over which design to use. One and five were eliminated without much trouble, but the remaining three were very evenly matched. Each effectively had one feature that distinguished it from the others. Additionally, the handle debate on design four was resurrected, though after thorough consideration we determined the grinder would be slightly less functional than the remaining designs. The coffee grinder that ultimately came out of this process was a combination of designs two and three. It incorporated the form factor and functionality of three with the clear plastic from two. This would allow the user to see its mechanism work to crush the beans and appeal to our target market. We also decided to make the handle detachable rather than collapsible. We judged this to be more effective, as were worried about the durability of a folding handle.

3.13. **Use CAD to create digital model**

The major obstacle in creating the 3D model of our coffee grinder was time. Due to the fact that we were only able to get an academic version of SolidWorks from WPI, we were unable to present anything we created on our own to Mikma. To create the model we needed access to their engineer's computers; these were the only machines with the program installed, and they had a limited number of licenses for the product. The engineers have full schedules, leaving an extremely limited amount of time for us to use their computers. After communicating with Mikma we were allotted one work day to draft the whole model, and were under pressure to finish in less than three hours. To offset these difficulties we fully modeled the coffee grinder in the student version of SolidWorks before going to Mikma. This was done in the hope of being able to import it into the professional version without having to re-draw everything. Due to technical difficulties however, these files were lost when we arrived at Mikma. While this presented a difficulty at the time, it effectively forced us to create another iteration of our coffee grinder design. We believe that this improved the design that we gave Mikma as an end result, as it forced us to re-examine all the parts we had originally created, and resulted in positive changes being made to many of them. Despite the short period of time we were given, the coffee grinder design was finished on schedule, and we were satisfied with the result.

3.14. **Get feedback on design**

Having completed a working 3D model of the coffee grinder, we wanted assurance that it would be as appealing to any consumer as possible. It was first presented to the Mikromashina engineering team for approval, who gave a positive response upon viewing the rendered design. At this stage we sent the design to a focus group for review. This was organized with the help of our Russian partners, who were invaluable both in the events organization, and in translating the results afterwards. As we had hoped, the consumers liked both the clear design and the adjustability, which are not available in other manual grinders on the market. There were, however, several aspects of the design that the focus group wanted changed. They disliked the use of plastic instead of glass, and expressed a desire for an overall higher quality of materials. It was also pointed out that the lack of markings on the adjustment mechanism could cause

confusion, and it would be easier to use if there were presets. Lastly, the flaring on the base of the grinder could make use of a scoop more difficult, which we had not previously considered. We felt that this was generally very constructive criticism of our product, and that acting on these reactions would improve our final design.

3.15. **Revise design**

Due to the very late stage of the project, we decided to create the final iteration of our design by acting directly on the feedback we received in the focus group. The adjustment mechanism was improved by adding marks for various coffees, such as Turkish and espresso, which the screw could be matched to. The flaring on the base was also eliminated, which proved to be a simple fix, and would actually make the coffee grinder significantly less expensive for Mikma to produce. While we understood the criticism of the plastic, as glass is generally perceived to be a higher end material, we ultimately decided to leave this aspect of the design as is. To make the body of a grinding device out of glass would be inherently dangerous due to risk of shards getting into the coffee. Additionally, it would mean that Mikma could not manufacture the majority of the grinder's parts. In an effort to meet this demand for high quality materials though, we used a high grade copolyester in the design of the grinders body, which in addition to being stronger than glass, is dishwasher safe and will not leech any flavor or scent into foods. We also changed the material of the burr grinder from case-hardened steel to ceramic, which will not wear, and is only found in very high quality grinders. We believed that the white material of the ceramic burr would contrast with dark coffee beans, and help the aesthetics of our design. At this stage, we had finally completed the design process of our coffee grinder and presented the final product to Mikromashina.

Chapter Four: Results

4. Introduction

The following section outlines the design of our concept coffee grinder, focus group feedback results, and the cost analysis report which our Russian colleagues developed. The design overview covers each component of the coffee grinder design in detail. Once the focus group was completed, the participant's reactions to the design were studied. The results from this study were used to further improve the design of the grinder. The cost analysis summarizes the prices of materials and manufacturing to produce the final concept design.

4.1. Coffee grinder design overview

Once our detailed design process was completed, the results were compiled into a final concept design. Using the program SolidWorks, a full 3D model of the final design was created. Each separate component of the design was modeled and combined into an assembly file. Seen below in Figure 16: Isometric View of Coffee Grinder is an Isometric view of the whole coffee grinder.

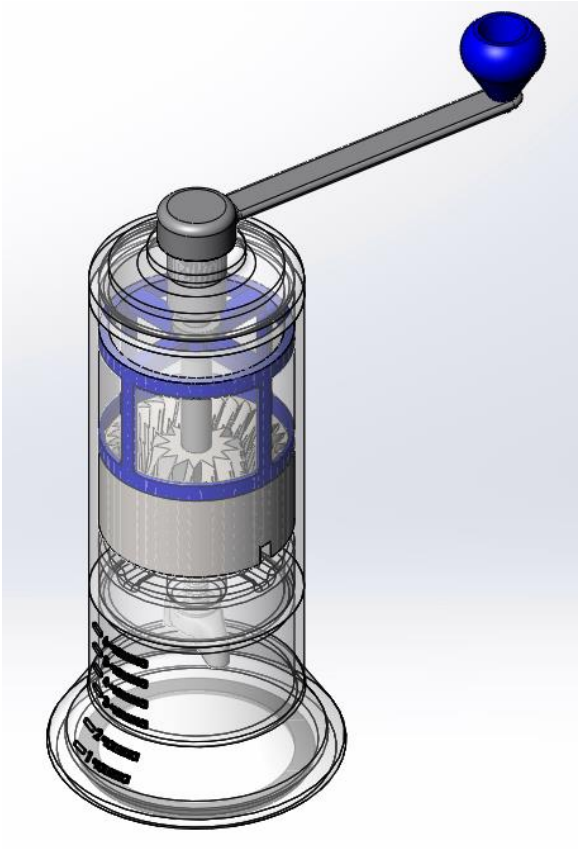

Figure 16: Isometric View of Coffee Grinder

This rendering of the gives a good idea of what the grinder looks like. The design is intended to be clean and minimalistic. The simplicity of the outer housings not only makes the grinder very attractive and modern looking, but also helps to lower manufacturing costs. Similarly to the exterior design, the overall internal mechanical design of the grinder is very elegant, and uses as few moving parts as possible. In addition to keeping cost down, this makes the grinder more reliable and easier to repair. For an enhanced aesthetic look the grinder's housings, lid, and bin are made of a clear copolyester plastic in order to allow the user to be able to see inside of the grinder. This allows the user to see into the grinding mechanism as it crushes the coffee beans, a feature which makes this grinder unique on the market. The handle is removable for easy cleaning and storage.

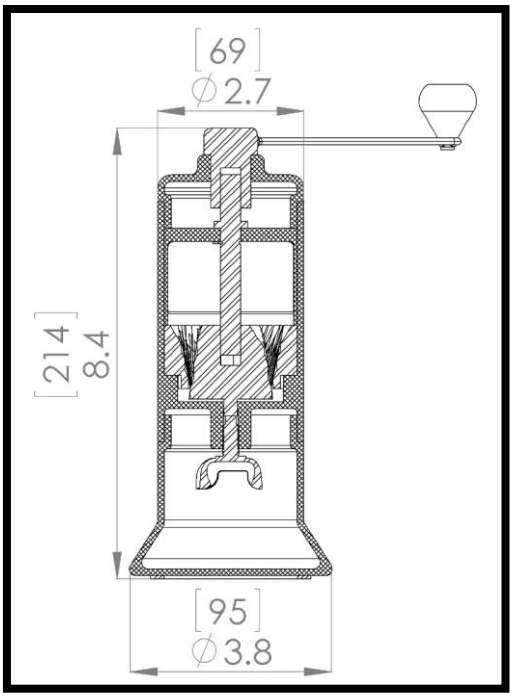

Figure 17: Section View of Grinder

The whole grinder weights approximately one kilogram and is able to process coffee grounds for about six cups of coffee in a single load. In Figure 17: Section View of Grinder, the overall dimensions of the grinder are given. The grinder is very compact relative to others on the market, and is suitable for most kitchen environments.

4.2. **Detailed views of each parts**

The grinder has 13 total parts. Figure 18: Exploded View gives an exploded view of all components used in the design.

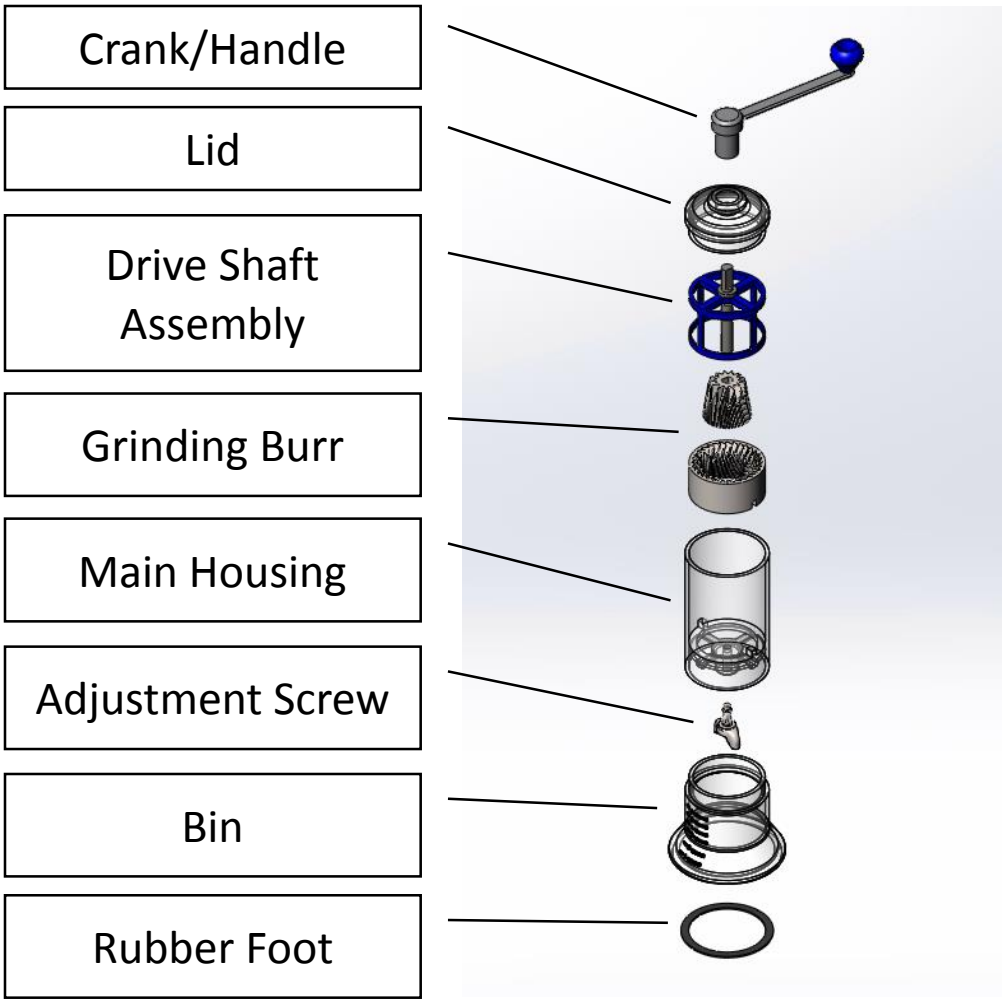

Figure 18: Exploded View of Proposed Manual Grinder

4.2.1. **Grinder Design**

The most important part in any coffee grinder is the grinding element. Since the target market for this design is the coffee enthusiast, the choice of a burr grinder design was preferred. The burr grinding assembly is made out of carbon steel and is a full size 63mm burr similar to those found in high end electric coffee grinders. The design is based off of the Mazzer Kony Italian burr. The outer burr has slots to mate with the matching tabs on the main housing, making the whole device simple to manufacture. A stub shaft on the bottom of the inner burr inserts into the support bearing in the main housing. The inner burr has a 3/8" D-profile bore to mate with the drive shaft assembly.

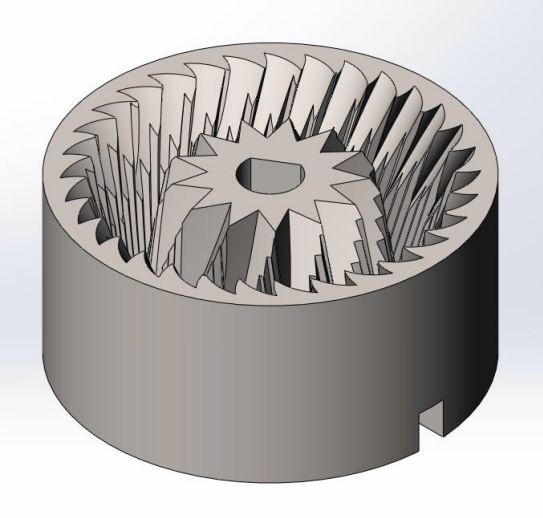

Figure 19: Burr Design

4.2.2. **Crank/Handle**

The job of the crank and handle assembly is to take the user's arm rotation and transfer this motion to the drive shaft assembly. The crank is made of chromed stainless steel for an attractive appearance and corrosion resistance. User comfort was the primary factor in this design. A plastic handle (Figure 18 - right) is mounted onto the end of the crank and is allowed to pivot freely for easier user operation. A C-clip holds the handle onto the crank without inhibiting its rotation. The bottom of the crank has a 3/8" D-profile bore that matches that of the drive shaft.

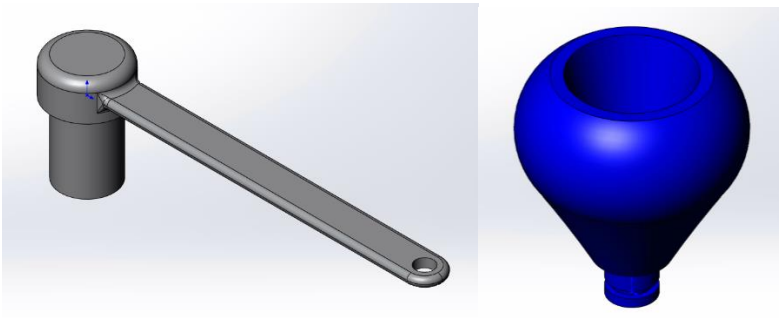

Figure 20: Crank and Handle Design

4.2.3. **Bin**

The bin's purpose is to gather coffee grounds once they are processed. This component uses a push fit to attach to the bottom of the grinder. The bottom is flared to add stability to the grinder while it is sitting on a flat surface. There are also graduated marks on the side of the bin to allow the user to measure up to six cups of coffee.

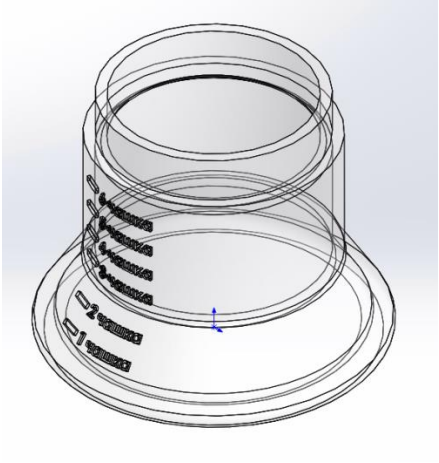

Figure 21: Bin Design

4.2.4. **Lid**

The lid serves three purposes: it acts as a bearing surface to the crank, keeps coffee beans from spilling out of the grinder during use, and keeps the user from touching the grinding element during operation. The lid is secured to the top of the grinder with a push fit but is easily removable for grinder operation.

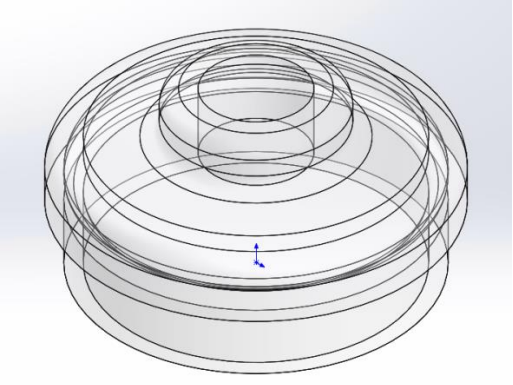

Figure 22: Lid Design

4.2.5. **Main Housing**

To help keep manufacturing costs low, the design of the main housing was kept as simple as possible. To hold the burr steady during use, the housing has tabs that mate with the outer burr. The housing has a bearing surface on the center support for the inner burr. This also has a 5/16x18 threaded hole to facilitate the adjustment system.

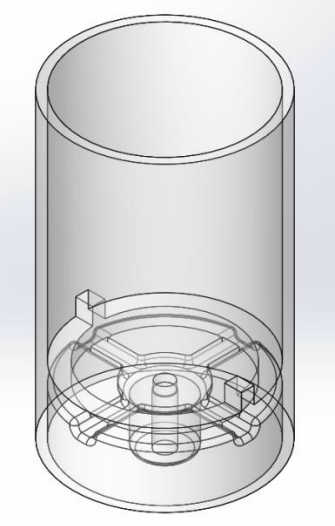

Figure 23: Main Housing Design

4.2.6. **Adjustment Screw**

A feature not typically seen in other manual coffee grinders is the ability to adjust ground fineness. This grinder design features an adjustment screw which allows the burr spacing to be changed. When the burr spacing is decreased, a finer ground is produced. This also allows the grinder to handle a wide range of foods such as spices, sugar, and cereals. Moreover, the design also allows for the production of fine coffee grounds used in some types of coffee such as espresso or Turkish coffee. The support shaft of the inner burr rides against the tip of the

adjustment screw. As the screw is turned the burr is raised or lowered as the tip of the screw presses against the shaft of the burr.

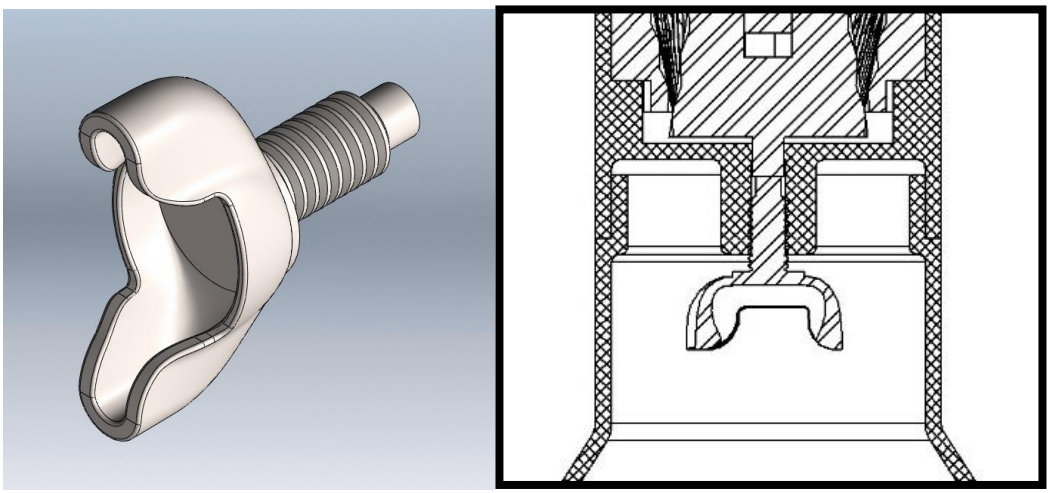

Figure 24: Adjustment Screw Mechanism

4.2.7. **Driveshaft Assembly**

The drive shaft assembly transfers power from the crank to the burr. It is made out of stainless steel and the bearing frame is made out of high strength plastic. The bearing keeps the shaft straight so the handle can easily be removed and inserted. To ensure that power is transferred reliably, the diameter of the shaft is 3/8". A shoulder on the shaft prevents it from sliding downwards along the vertical axis, while an E-clip stops the shaft from moving upwards. The shaft uses a D-profile, a cylinder with a flattened side, to transfer rotational torque.

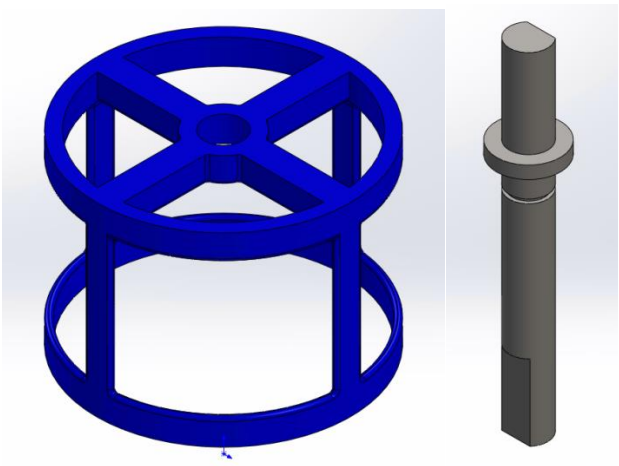

Figure 25: Drive Shaft Assembly

4.2.8. **Rubber Foot**

The rubber foot is mounted to the bottom of the bin, and keeps the grinder from slipping while sitting on smooth surfaces. This makes the grinder easier to use and less likely to break due to falling. It is made out of polyurethane rubber with an adhesive backing to permanently bond with the bin.

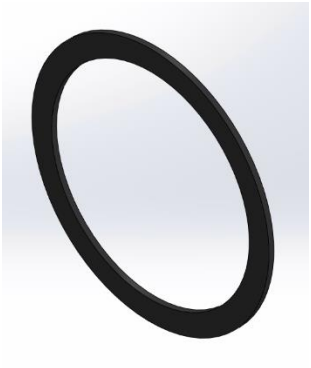

Figure 26: Rubber Foot

4.3. **Focus Group Feedback**

Upon the completion of the first design model, a focus group was conducted with a panel of middle aged adult Russian consumers. The concept design was displayed to this panel and the each participant's reactions towards the design were recorded on video. After analyzing this footage, a list of likes and dislikes was created.

4.3.1. **Likes**

- Size: The focus group felt that the grinder was sized well.
- Convenient to use: Does not need to be plugged into a wall and can be ready to grind quickly.
- Multi-functionality: The ability to grind products such as porridges, nuts, and spices in addition to coffee was also seen as important.
- Capacity: An optimal number of 6-8 cups was decided upon which is in agreement with the concept design.
- Clear design: The choice of clear material was well received.
- Durable materials: The use of materials such as stainless steel and high quality copolyester plastics were well received.
- Produced in Russia: Country of manufacture was a significant factor to the focus group. The group was against buying goods from China.

4.3.2. **Dislikes**

- Plastic materials: A large amount of discussion focused around the use of plastic materials. Most felt that materials such as glass and ceramics should be considered.
- Unclear adjustment settings: During the description of the adjustment system a few members were confused about its operation. A redesign of the system should be looked into to make it more user-friendly.
- Hard to use scoop with bin design: The group did not approve current bin design and suggested that we improve it and make it easier to scoop out coffee grounds.

4.3.3. **Design Recommendations**

- Remove angled bin: To make the bin easier to use with a scoop, the angled part of the bin should be revised.
- Marks on adjustment screw: To allow the user to know what fineness selection is chosen, marks should be added to the adjustment screw.

- Other materials for grinding burr: several participants expressed the desire for the use of other materials, such as ceramic, in the grinding element.
- Include instruction/recipe booklet: To help new users make specialty coffee, a recipe guide should be included with each grinder.

4.3.4. **A Note About Glass Materials**

Due to the unsafe nature and economic unviability of using glass in a coffee grinder, the recommendation of using glass instead of plastic was discarded. We feel the use of copolyester plastics will address any material concerns. In addition to being stronger than glass, copolyester is dishwasher safe and does not leech flavor or scent into foods.

4.4. **Design Refinement**

Following the focus group feedback, several design refinements had to be made. These included the redesigning of the bin, improvement of the adjustment system, and the inclusion of a ceramic burr.

4.4.1. **Redesign of Bin**

One complaint during the focus group was that the bin design shown would be difficult to use with a scoop, due to the angled walls. This is shown in Figure 25. To eliminate this issue the inner walls of the bin were straightened. To save material, while retaining the flared bin design, a cavity was created between the walls.

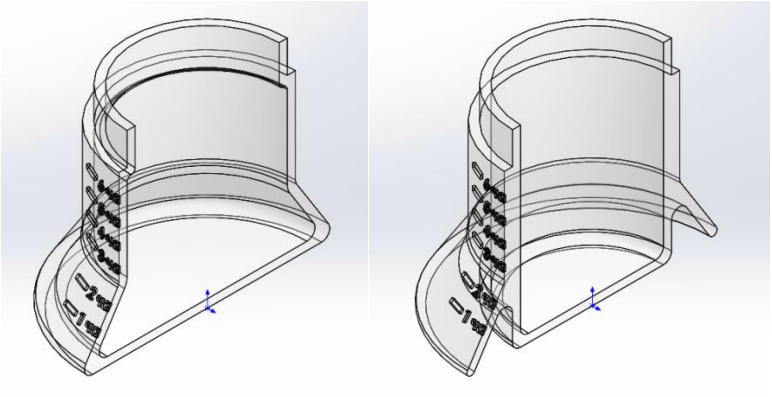

Figure 27: Left: Old Bin Design, Right: New Bin Design

4.4.2. Redesign of Adjustment System

After explaining the adjustment system to the focus group, several members were confused about its operation. The adjustment screw has no indicator marks, so the user has to dial the grinder in to specific types of coffee by trial and error. To resolve this issue, the adjustment screw was redesigned to include indication marks. This allows the user to repeatedly adjust the grinder to the same setting, taking the guesswork out of adjusting the grinder to a particular food item.

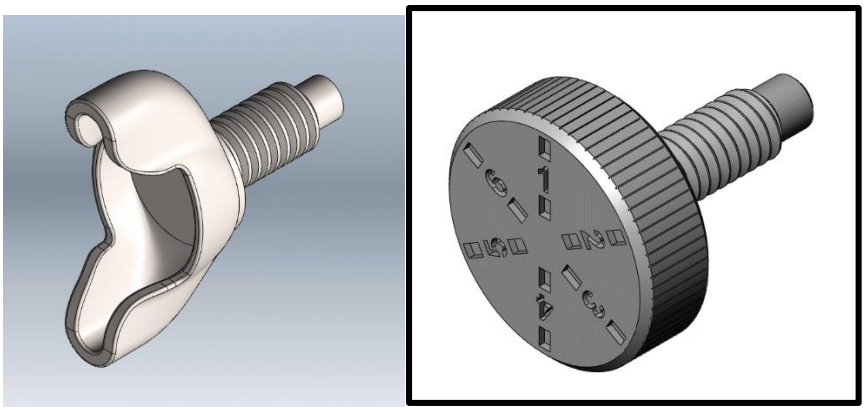

Figure 28: Left: Old Adjustment Screw, Right: New Adjustment Screw

4.4.3. Ceramic Burr Grinder

Several participants of the focus group desired a ceramic grinding element instead of a steel one. While steel is adequate in most grinders, ceramic is more desirable due to its increased surface hardness. This allows the burr's cutting edges to last longer, even with heavy use. However, ceramic burrs are more expensive to produce than steel burrs. The design and size of the burr would remain similar to the steel design. The burr would be made out of 95% alumina ceramic.

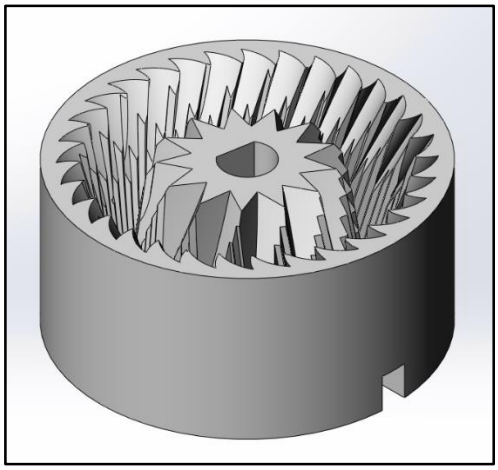

Figure 29: Ceramic Burr

Chapter Five: Economic Analysis

5. **Introduction**

The financial analysis concerns the costs and potential profitability of the new coffee grinder. The calculations are aimed at obtaining the break-even price on the basis of variable costs. The results of our estimations were compared with the average market price of mechanic coffee grinders in Russia.

5.1. **Cost Model**

The classical model of profit optimization involves calculating the optimal output on the basis of marginal costs and marginal revenue and then setting the price in accordance with the demand. This technique gives accurate and reliable results, ensuring that the company gets the most of selling its products. However, when trying to apply the model to our case, we faced some serious constraints:

- We do not have enough data to construct the marginal cost and marginal revenue curves, so we cannot use the classical MR = MC equation to determine the optimal output

- The optimal output might not be feasible, taking into account the production capacity of Mikma's machinery

- There is no detailed data concerning the demand for mechanic coffee grinders in Russia as the product is very specific

Meanwhile, we had detailed quantitative information concerning all inputs required for production (based on the actual CAD model). Besides, we had an opportunity to find out the prices of these inputs directly from Mikma plant. That is why the basic method employed in our analysis is the **cost-plus pricing** (or **markup pricing**). There are several varieties of it, but we used the most widespread one, which involves calculating the costs of the product, and then adding a proportion of it as a markup:

$P = AVC + AFC + markup$

However, we added some significant changes when using the cost-plus pricing model. Firstly, we thought it would be better to leave adding the markup to Mikma's management, because they are more aware of the current market situation and can work it out in a more accurate way. Instead, we obtained the break-even price for the grinder and compared it to the average market price for the same good – the results are the basis for the markup. Secondly, we decided not to include fixed costs when calculating the price, because it is impossible to know in advance the appropriate method of their distribution between different products of the company. Again, the management can use the difference between the break-even and market prices to determine the final price and use a portion of revenue to make up for fixed costs. Hence, we assumed that

$AFC = 0$
$Markup = 0$

$P = AVC$

5.2. **Analysis Overview**

Firstly, we calculated the feasible output on the basis of the production capacity of Mikma's machinery. We received the information that the process of making the plastic parts of the grinder lasts 45 seconds. We assumed that all the three machines employed in the process of production will work simultaneously and will require the same time for producing all parts, and we gave additional 15 seconds for mechanized assembly of each grinder. Assuming that the machines work 10 hours a day (a standard shift) 5 days a week, arrive at the feasible monthly output:

Minutes per unit produced	Working hours (machine in operation)	Time the machine works per month (minutes)	Total feasible output of grinders per month
1	10	18 000	18 000

Table 1: Production Output

It is clear that the obtained figures can be adjusted easily during the practical implementation of the project. Secondly, we used the information provided to us by Mikma as well as the figures obtained in the designing process to calculate the variable costs of producing one coffee grinder (you can see the results in the table below):

Input	Price	Quantity	Average cost
Plastic	115 rub/kg	0,305 kg	35,075 rub
Steel	226,5 rub/kg	0,736 kg	166,704 rub
Labor	21 140 rub/month	6 people	7,05 rub
Hourly rate of machinery	1 080 000 rub/month	3 machines	180 rub
Depreciation of machinery and molds	35 741 rub/month	3 machines	5,9568 rub
Additional details	14,32 rub 10,98 rub 47,44 rub	3 details	72,74 rub

Table 2: Production Costs

Thirdly, we included some additional costs basing on the information we managed to find by ourselves. For example, after examining price lists of advertising agencies, we found out that the cheapest and the most efficient means of advertising are the Internet adverts in on-line shops and booklets and flyers presented in shops where our grinders may be

sold. After examining the adverts for existing mechanic grinders of our potential rivals, we came to the conclusion that this type of products is most likely to be sold in large outlets with various household goods (e.g. Tvoy Dom, Ikea), in specialized household stores (e.g. Eurodom), in souvenir shops and in gift shops. Basing on most frequently met prices for advertising services, we got the following results:

On flyers and booklets, rub/month	On Internet adverts, rub/month	Transactional costs, rub/month	Costs per 1 unit of output, rub
200 000	200 000	100 000	27,78

Table 3: Cost of Advertising

Besides, we need to take into account additional expenses on delivery, customer services and fees charged by the shops. However, these figures totally depend on the volume of sales of final products. Nevertheless, we considered it reasonable to include these expenses in the price by adding 10 rubles on each account:

Delivery	Customer services	Fees charged by shops
10 rub/item	10 rub/item	10 rub/item

Table 4: Customer Service Fees

Clearly, the model does not cover up all variable costs – some of them cannot be defined until the actual production begins. That's why we included additional 15% of the obtained results in order to cover the omitted expenses (on adjusting the equipment to producing the new product, on additional market research, and so on).

Thus, we arrive at the ultimate break-even price for the new coffee grinder:

P = 604 rubles

5.3. **Research of market prices for mechanical coffee grinders**

In order to understand what prospects our model would have on the market, we conducted a small research on the market of mechanical grinders. We found 127

mechanic coffee grinders offered in on-line stores and in ordinary shops, analyzed their prices and got the following results:

Minimum price, rub	300
Average price of 5 cheapest models, rub	506,25
Average market price, rub	1851,59
Average price of 5 most expensive models, rub	4647,5
Maximum price, rub	6650

Table 5: Coffee Grinder Costs

As you can see, the break-even price of Mikma's mechanic coffee grinder is reasonably low – compared to the average market price for this type of goods in Russia. Thus, if Mikma decides to set the price for the new grinder at the average market price, it will have additional 1247 rubles to cover fixed costs, set up markup and get revenue.

5.4. **Conclusion**

Relatively low break-even price of the new model, compared to the average market price of mechanic coffee grinders, establishes a comparative advantage in the price and promises high returns. The variety of prices on the market gives Mikma relative freedom in pricing, which is also very important because it decreases risks the company faces when launching a new product. All these factors make the project very promising from financial point of view.

Chapter Six: Recommendations

6. Introduction

In our time working on this project, we have laid the groundwork for a product that we believe can be very successful in the Russian market. However, in order for our design to actually succeed, there is a non-trivial amount of work that needs to be done. In this section, we have outlined a series of steps that will lead Mikma to the production phase for this product.

6.1. Develop working prototype

Building on our CAD model and specifications, Mikma should aim to build a functioning physical prototype of the grinder. At this point, it is not important that the prototype is an exact copy of its digital representation. However, it should contain all major features: the adjustable burr grinding mechanism, the removable handle, and the rubber foot.

6.2. Trial Study of prototype

Once complete, the prototype should be put through a trial study to gain an idea of how the product will work in practice. This study should first focus on its durability. It should be exposed to different conditions that it could potentially see in the household, including physical stresses, use at different temperature ranges, use at different angles, and use over an extended period of time.

The study should next focus on gathering qualitative data surrounding the prototype. This can be done by bringing it to focus groups and expert panels, similar to those during the refinement phase of our methodology. This will help to gauge opinions on the coffee grinder's overall design and usability.

6.3. Further refinement of design

After the trial studies of the prototype, the major strengths and weaknesses of the design should be made very clear. At this point, small refinements should be made to reduce or eliminate any flaws. These refinements could affect many different aspects including shape, ergonomics, and color. The goal of this phase, however, is not to change the

overall design, but rather to perfect this one. If, at the end of this phase, the company is not satisfied with the design, it can undergo any number of iterations to obtain a truly satisfactory product.

6.4. **Examine economics and manufacturing methods**

This coffee grinder is made up of a list of different parts; some can be manufactured at Mikromashina, while others cannot. It will be important for the company to analyze each of these components for the best and most cost-effective methods of manufacturing. This analysis should also aid in predicting the profit margins and success of the product.

Chapter Seven: Conclusions

7. Introduction

We regard our project as a strong success. First and foremost, we fulfilled both the letter of our deliverables and the spirit of our initial project goals. We incorporated market research and consumer feedback into our final design, and are confident this shows in its quality.

7.1. Cooperation with Russian colleagues

Our cooperation with Russian partners added its own challenges to the project, but had a profound impact on our end result. Our initial idea for this project included no financial analysis, but our cooperation with the Financial University allowed us to see its benefits. The inclusion of this economic data lends added credence to our design, and is likely to make the coffee grinder easier to produce and sell. The Russian students were also invaluable in organizing the focus groups that were responsible for some of the most important improvements on our design.

7.2. Future of Mikma

While we regard this project as a success, we hold no illusions that this coffee grinder should become Mikma's new flagship product. As we concluded that coffee grinders form a niche market, we designed a product that can thrive in that environment and prove extremely profitable. That said, coffee grinders cannot form an effective sales base for a company of Mikromashina's size. We consider this to be the first in a line of projects to rejuvenate Mikma's aging product line, and bring back its former market share. If consumer needs are considered in the design process for all future products, we believe all Mikma products can achieve commercial success. After a series of these products, and an adequate marketing campaign, the Mikma brand has great potential to regain the visibility and reputation it once had.

7.3. Greater significance to Russian Market

It is clear that the coffee grinder we designed is a very small aspect of the small appliance market as a whole. What it represents though, is first step in bringing a Soviet era

company into the modern world, with all the business and engineering strategies that that entails. Mikma, like many other Soviet-era companies, found itself unable to compete with the influx of foreign companies after the collapse of the Soviet Union. If successfully implemented by Mikma, our project could demonstrate that it is possible for those Russian entities to compete with the rest of the world. We expect this to provide a foundation upon which others could model business updates, and succeed in the market.

Bibliography

Ascaso M-I Bean Hopper. (2013). *DiBartoli.* Retrieved 9/26/13, from http://dibartoli.com.au/ascaso-m-i-bean-hopper/

Bojor, J. (2010). The Household Appliances Market In CE, SE And Eastern Europe. *FRD Center*. Retrieved 3/17/13, from http://www.frdcenter.ro/assets/FRD-Center-Household-appliances-market-CE-SE-and-Eastern-Europe-DEMO-report.pdf

Burr Grinder vs Blade Grinder – Which One Is The Best? (2013). *Coffee Grinder Check.* Retrieved 9/22/13, from http://coffeegrindercheck.com/burr-grinder-blade-grinder

Communicating Grind Size. (May 2010). *Galla Coffee.* Retrieved 10/14/13, from http://www.gallacoffeeblog.co.uk/communicating-grind-size/

Eisenblätter, M. (August 2012). LIGHT AND DARK: SMALL DOMESTIC APPLIANCES IN EUROPE.

Engineering Design Process Chart. (2013). *fhwa.dot.gov.* Retrieved 10/14/13, from http://www.ops.fhwa.dot.gov/publications/regitsarchguide/73useprojimpfiles/tradprojdev.png

Frew, A. (2007). Choosing a Grinder. *Coffee for Connoisseurs.* Retrieved 10/14/13, from http://www.coffeeco.com.au/articles/september2002.html

Grinder burr types explained (flat, conical, DRM). (2006). *Home Barista.* Retrieved 10/14/13, from http://www.home-barista.com/grinders/grinder-burr-types-explained-flat-conical-drm-t1672.html

Grinders 101 - A Beginners Guide. (2013). *Whole Latte Love.* Retrieved 10/3/13, from http://www.wholelattelove.com/articles/grinders_101.cfm

Hario Ceramic Coffee Mill Skerton. (2013). *Amazon.com.* Retrieved 10/6/13, from http://www.amazon.com/Hario-Ceramic-Coffee-Mill-Skerton/dp/B001802PIQ/ref=sr_1_1?s=home-garden&ie=UTF8&qid=1381681916&sr=1-1&keywords=hario+ceramic+mill+skerton

IBISWorld Global Industry: Company and Business Research Reports and Information. (2013). *IBISWorld.* Retrieved 3/13/13, from http://clients1.ibisworld.com.ezproxy.wpi.edu/reports/gl/industry/productsandmarkets.aspx?entid=930

IBISWorld US Industry: Company and Business Research Reports and Information. (2013). *IBISWorld.* Retrieved 3/13/13, from http://clients1.ibisworld.com.ezproxy.wpi.edu/reports/us/industry/default.aspx?entid=4262

KRUPS GVX212 Coffee Grinder. (2013). *Amazon.com.* Retrieved 10/5/13, from http://www.amazon.com/KRUPS-Grinder-Selection-Stainless-Conical/dp/B0001I9R8W

KRUPS GX4100 Electric Spice Herbs and Coffee Grinder. (2013). *Amazon.com.* Retrieved 10/7/13, from http://www.amazon.com/KRUPS-Electric-Grinder-Stainless-Housing/dp/B0007Y6BQQ/ref=sr_1_1?s=home-garden&ie=UTF8&qid=1381681827&sr=1-1&keywords=krups+gx4100

La Pavoni PA-JV Jolly Burr Grinder. (2013). *Amazon.com.* Retrieved 9/27/13, from http://www.amazon.com/La-Pavoni-PA-JV-Jolly-

Grinder/dp/B000FEJAXO/ref=sr_1_1?s=home-garden&ie=UTF8&qid=1381681957&sr=1-1&keywords=la+pavoni+jolly+burr
. Market Research Report August 2011. (August 2011) *Appliance Magazine*.
Martinchik, A. N., Baturin, A. K., Martinchik, E. A., & Tutel'ian, V. A. (2005). Tea and coffee consumption among Russian population. *Vopr Pitan*.
Mikma IP-30 product reviews. (2013). *Yandex.* Retrieved 9/16/13, from http://market.yandex.ru/product/4806433/reviews
Mikromashina resources. (2013). *Mikma.* Retrieved 9/3/13, from http://mikma.com/
Mr. Coffee BVMC-BMH23. (2013). *Amazon.com.* Retrieved 10/6/13, from http://www.amazon.com/Mr-Coffee-BVMC-BMH23-Automatic-Grinder/dp/B004T6EJS0/ref=sr_1_1?s=home-garden&ie=UTF8&qid=1381681847&sr=1-1&keywords=Mr+coffee+automatic+burr+grinder
Mr. Coffee IDS57-4. (2013). *Amazon.com.* Retrieved 10/6/13, from http://www.amazon.com/Mr-Coffee-IDS57-4-Grinder-Black/dp/B00005OTXM/ref=sr_1_2?s=home-garden&ie=UTF8&qid=1381681879&sr=1-2&keywords=Mr+coffee+black+blade+grinder
Russia leads Europe's small appliance growth. (September 2011). *Housewareslive.* Retrieved 3/14/13, from http://www.housewareslive.net/news/news.asp?id=7328&title=Russia+leads+Europe's+small+appliance+growth
Russian Coffee Market Trends. (2013). *Orimi Trade Holding.* Retrieved 3/15/13, from http://www.orimitrade.ru/e/russian-coffee-market-trends/
Scheirs, J. (2003). Modern polyesters: chemistry and technology of polyesters and copolyesters. Hoboken, NJ: John Wiley & Sons.
The 2005-2014 Outlook for the Coffee Market in Russia. (2010, 2010/12/02/). Article, *M2 Presswire*. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE
WRI Coffee Consumption Map. (2009). *ChartsBin.* Retrieved 3/13/13, from http://chartsbin.com/view/581

Appendix A: Coffee Grinders on the Market

	
Make	Krups
Model	GVX212
Price	$69.99
Grinding Element	Burr grinder
Other noteworthy features	8oz bean hopper, locking mechanism, customizable fineness
("KRUPS GVX212 Coffee Grinder," 2013)	

	
Make	Krups
Model	GX4100
Price	$29.99
Grinding Element	Stainless steel blade
Other noteworthy features	Can be used to mince herbs
("KRUPS GX4100 Electric Spice Herbs and Coffee Grinder," 2013)	

	
Make	Mr. Coffee
Model	Automatic Burr Mill Grinder
Price	$40
Grinding Element	Burr
Other noteworthy features	18 separate grind settings, removable bean hopper, cord storage
("Mr. Coffee BVMC-BMH23," 2013)	

	
Make	Mr. Coffee
Model	Black Blade Grinder
Price	$17.99
Grinding Element	Blade
Other noteworthy features	Rubber feet for stability
("Mr. Coffee IDS57-4," 2013)	

Make	Hario
Model	Ceramic Coffee Mill Skerton
Price	$40
Grinding Element	Manually driven burr
Other noteworthy features	Glass exterior, lightweight

("Hario Ceramic Coffee Mill Skerton," 2013)

Make	La Pavoni
Model	PA-JV Jolly Burr Grinder
Price	$470
Grinding Element	Steel conical burr
Other noteworthy features	Very expensive, industrial grinder, can grind spices and different kinds of coffee, very customizable

("La Pavoni PA-JV Jolly Burr Grinder," 2013)

Appendix B: Coffee Grinder Feature List

Coffee Grinder Feature List		
Brand Related	**Aesthetic design (cool factor)**	**Grinding Designs**
10. "Russian made"	Stainless Steel	13. Conical Burr grinder
85. Brand decals printed on product	Hard Edges	12. food processor grinder
86. Brand decals glued on product	34. Different Colors	30. Wheel Burr grinder
	2. Leds	57. Low friction coatings on burr
	27. flat back (good to put against a wall)	72. Top rotating manual burr mill (opposed to handle)
	49. All natural materials	73. Individually case hardened burrs
	Use of wood	74. Ceramic grinding element
	Matryoshka doll	77. Flat blade grinder (like on current mikma design)
	65. indented border patterns on parts	78. Carbon steel grinding element (most efficient for most things, but unsuitable for salt)
	92. plastic and chrome options	81. Roller grinding
	Rounded edges	83. Vertical roller mill (may help aesthetically)
	bland colors	84. Hammer mill grinder
	use of chrome	
	Exposed Screws	Complexity:
	Curved Surfaces (Organic Shapes)	1
	Flat Surfaces	2
	Bright colors	3
	burnished metal for aged appearance	4
	exposed mechanisms	5
	Plastic Surfaces	
Hopper Design	**Bin Design**	**Safety**
17. removable hopper (cleaning)	16. removable bin (cleaning)	15. autolocking top/lid
5. Bean hopper	39. Dock for scoop(or hanger if it has cord)	26. Stability

19. grade marks on hopper	36. pouring Spout on bin (like on a pitcher)	41. Safety cutoff switch
44. Dishwasher safe hopper/bin		40. motor turn off (heat sensors or just timed)
96. plastic "pushers" in hopper to ensure beans go into grinding hole	64. Locking mechanism for bin	43. Auto cutoff when hopper removed
funnel shape	90. multiple bin sizes/portafiller/spares	89. safety feature to prevent grinder activation while hopper/lid is open
		Guards to keep from grinding fingers
Ease of Use	**Poly Function**	**Power Source**
8. Easy push buttons	1. Ability to grind spices/sugar	29. Hand powered
6. Timer	46. Coffee Maker built in	42. High power motor
35. Screen	58. Interchangeable grinding heads for different foods	50. Solar Power
4. Non-stick lid	59. Interchangeable hoppers for different foods	76. Chargeable battery backup
9. Cord winding/storage device	60. Quick change system for different grinding heads	93. Reduction gearing (lowers motor speed, and coffee dust)
11. Clear lid	62. Adjustable burr grinder spacing (for different foods)	
14. ability to see grounds		
25. Rubber feet		
18. includes cleaning brush		
45. contrasting colors on dials(ease of use)		
20. long cord		
32. Scoop		
61. Auto detection of grinding head (for quick change system)		
38. auto-clean feature		
63. Spillover area for grounds around bin		
Textured Grips		
68. Able to dispense grounds into standard coffee bags		
69. Includes supply of standard coffee bags		

71. Disengage able burr mill (for cleaning and ground consistency)		
88. screen with presets for various cofffee types		
94. glass vs. Plastic hoppers/bins (some claim static reduction)		
User Comfort	**Lid Design**	**Bean Fineness**
3. Quiet	21. push button to open top	31. Preset Settings
37. Sleep mode	22. twist top(threads)	7. Multiple settings
53. Hopper/bin handle	Snap Lid	62. Adjustable burr grinder spacing (for different foods)
Ergonomically designed handle		28. Giant dial to adjust bean coarseness
		80. Display giving flavor strength per ground coarseness
		82. Variable distance in rollers for variable coarseness
Volume Control	**Heat Management**	**cleanliness**
33. Amount settings (volume of grounds produced)	54. Coffee bean cooling fan	79. Device to vacuum pack detachable coffee bags
47. dispenses a single serve	55. Vents (for motor heat)	
66. Calculated volume of dispensed grounds	56. Motor Fan	91. airtight ground transfer system (see above link for example)
67. display for actual volume of dispensed grounds	75. Some form of heat sink (for both motor and grinding element)	95. Indent/hole for stowing cleaning brush
70. Display of cups that can be served by volume of grounds		

Appendix C: Coffee Grinder Concept Analysis

Design 1		Design 2	
Pros	Cons	Pros	Cons
Cheap to produce	Possibility of over tightening/loosening	Bin will not loosen/over tighten	difficult bean loading

Simple to use	handle difficult for loading beans	aesthetic factor differentiates from market	fragile handle assembly
disassembly for cleaning		cheap to produce (probably cheaper than design 1)	
		simple to use	
		disassembly for cleaning	
		Quick release handle	
Design 3		Design 4	
Pros	Cons	Pros	Cons
Fold down Handle	More expensive materials	easy bean loading	more complex (possibly higher price)
bin will not loosen/over tighten		bin will not loosen/over tighten	Cleaning difficulty (more effort to disassemble)
Increased durability		Simple to use	
Simple to use			
Design 5			
Pros	Cons		
Automatic storage for grounds	difficult bean loading		
bin will not loosen/over tighten	harder to clean (cannot remove bin)		
Simple to use			

Appendix D: Focus Group Data

Likes:

- convenience, multi-functionality (it is important to have an opportunity to use coffee grinder not only for grinding coffee, but for other products, for instance, for making porridges for children, for grinding nuts and different spices.)

- Capacity (the quantity of coffee cups at once). The optimum number is 6-8 cups.
- Durability.
- Country - producer (the package should reflect the country-producer, as nobody is interested in buying a cheap product, made in China)

Dislikes:

- Another bin design (to make it easy to scoop ground coffee)
- Other materials (such as glass and ceramics, in this way our product will be more presentable)

Recommendations:

- include a booklet with advice and recipes for making different kinds and sorts of coffee.
- Redesign bin
- Other materials (such as glass and ceramics, in this way our product will be more presentable)

I would like to present some points that we analyzed after the work with the focus-group. They pointed out some advantages of our product. Clear design is the first and major advantage, and the focus group liked it. Multi-functionality is important for the customers, they want to have an opportunity to use coffee grinder not only for grinding coffee but for other products, for instance, for making porridges for children, for grinding nuts and different spices. Capacity is also an essential criteria and we achieved an agreement that the optimum number is 6-8 cups. We understood that the country-producer is a significant factor for customers, so it is a great advantage that our product will be made in Russia. Nobody is interested in buying a cheap product made in China. Here are some disadvantages, dislikes from the focus-group, too. They did not approve current bin design and suggest to improve it and make it easy to scoop ground coffee. There were also recommendations such as including a booklet with advice and recipes for making different kinds and sorts of coffee. A lot of attention was aid to the point concerning using other materials such as glass and ceramics. In this way our product will

be more presentable. Due to the unsafe nature of using glass in a coffee grinder, the recommendation of using glass instead of plastic was discarded.